Hurricane and Storm Damage Reduction Concepts

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Objectives

Provide an overview of the types of projects that the Corps typically is involved with in the coastal zone.

Described shore protection alternatives.

Introduction to the planning issues associated with Hurricane and Storm Damage Reduction projects.

Briefly identify data needs of coastal engineer.

References

ER 1105-2-0100, Planning Guidance Notebook

EM 1110-2-1100, Coastal Engineering Manual

***Shore Protection Manual*. 1984. 4th ed., 2 Vol., U.S. Army Engineer Waterways Experiment Station, U.S. Government Printing Office, Washington, D.C.,**

Types of Corps Projects in the Coastal Zone

- Navigation
- Flood Damage Reduction
- Coastal Storm Damage Reduction (Erosion)
- Hydroelectric Power Generation
- Recreation
- Water Supply
- Multiple Purpose Studies

  Hurricane and Storm Damage Reduction

What are the two principal factors that make planning for coastal storm damage reduction different from fluvial flood damage reduction?

A. Storm-induced beach recession

B. Wave forces

Study Phases

1. ***Reconnaissance***
2. ***Feasibility***

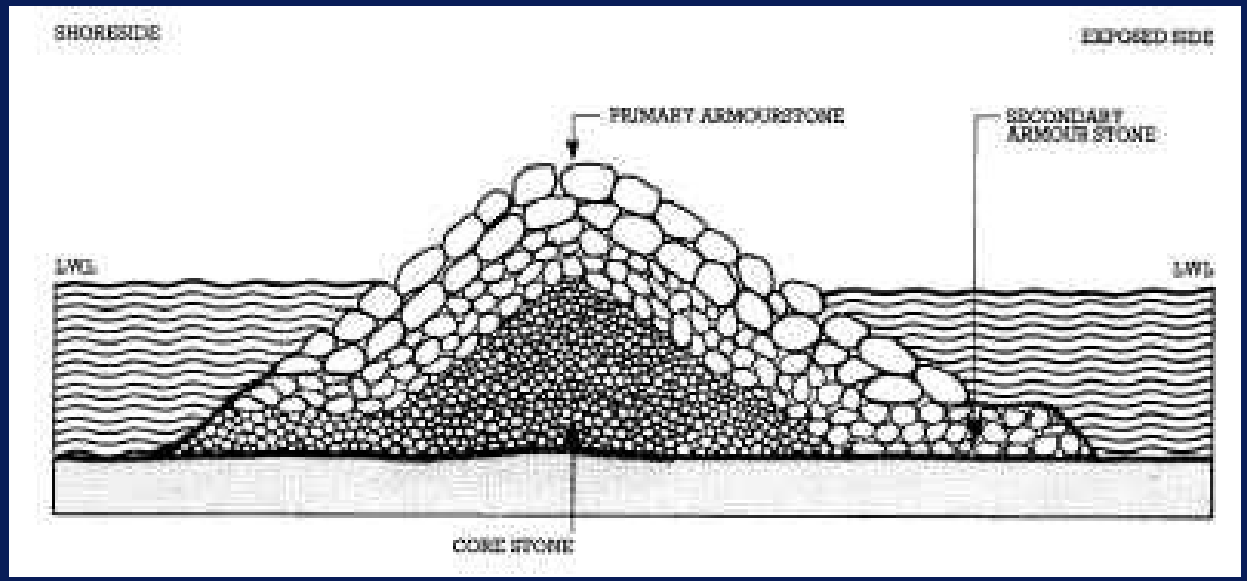
   The Corps planning process follows the six-step process defined in the Principles & Guidelines:

   Step 1 - Identifying problems and opportunities
   Step 2 - Inventorying and forecasting conditions
   Step 3 - Formulating alternative plans
   Step 4 - Evaluating alternative plans
   Step 5 - Comparing alternative plans (w & w/o project)
   Step 6 - Selecting a plan
3. ***Design/Plans and Specifications***

   (PED – Preconstruction Engineering and Design)
4. ***Construction***
5. ***Monitoring/Project Performance***

A Few Facts …

- Most navigation structures are federally owned and maintained.
- Most shore protection structures are locally owned and maintained.
- USACE maintains a large inventory of over 500 coastal structures, where most of the hard structures are rubble mound.



USACE Navigation Mission

SECTION 111 - Mitigation of Damages Caused by Federal Navigation Projects

Majority of work:

- Channel Design
- Sand Bypassing
- Jetties and Breakwaters
- Inlet migration
- Structured or natural
- Open or close, narrow or widen

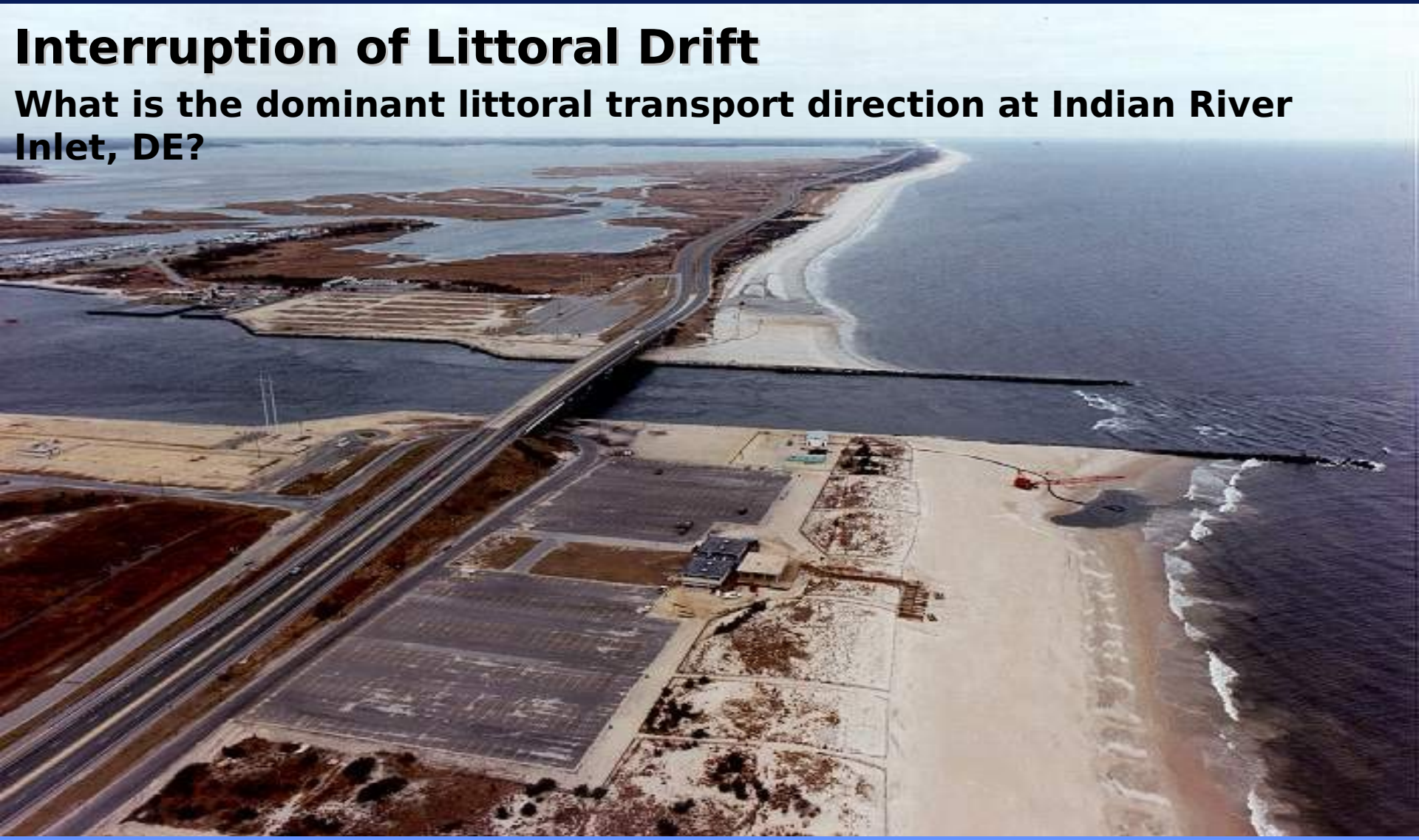
Factors to consider:

- Recreation vs. commercial
- Deep draft vs. shallow
- Navigability, shoaling
- Bay flood susceptibility
- Flooding ~ inlet size
- Bay water quality
- Salinity, circulation, species

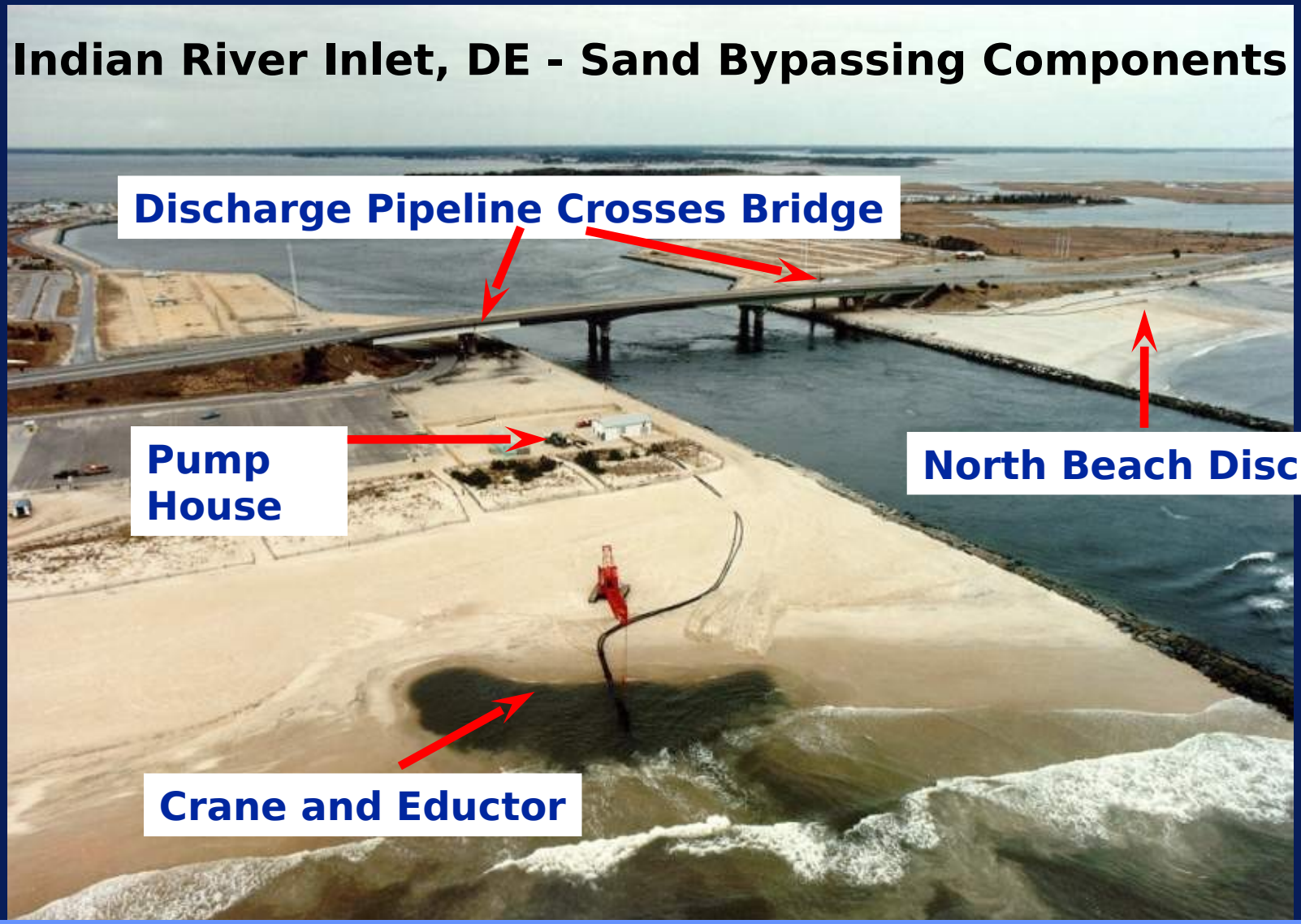
Navigation Projects

Interruption of Littoral Drift

What is the dominant littoral transport direction at Indian River Inlet, DE?



Navigation Projects


Indian River Inlet, DE - Sand Bypassing Components
Discharge Pipeline Crosses Bridge
Pump House
North Beach Discharge
Crane and Eductor

USACE Hurricane and Storm Damage Reduction Mission

To prevent or reduce damage caused by wind, tidal generated waves and currents along the Nation's coasts and shores

USACE HSDR Mission

Wave

Erosion

Flooding

(Inundation)

Wave Attack Damage

Flooding (Inundation) Damage

Erosion Storm Damage

Overview of Shore Protection Alternatives

Structural

- Revetments
- Seawalls
- Groins
- Jetties
- Breakwaters

Non-Structural

- Flood proofing
- Managed Retreat
- Zoning
- Buy outs

Beachfill

Coastal Structures

HARD (non-erodible) vs. SOFT (erodible)

Seawalls/Dikes

Revetments

Bulkheads

Breakwaters

Groins

Reefs

Jetties

Beachfill

Dunes

Marshes

Bioengineered

Coastal Structure Functional Areas

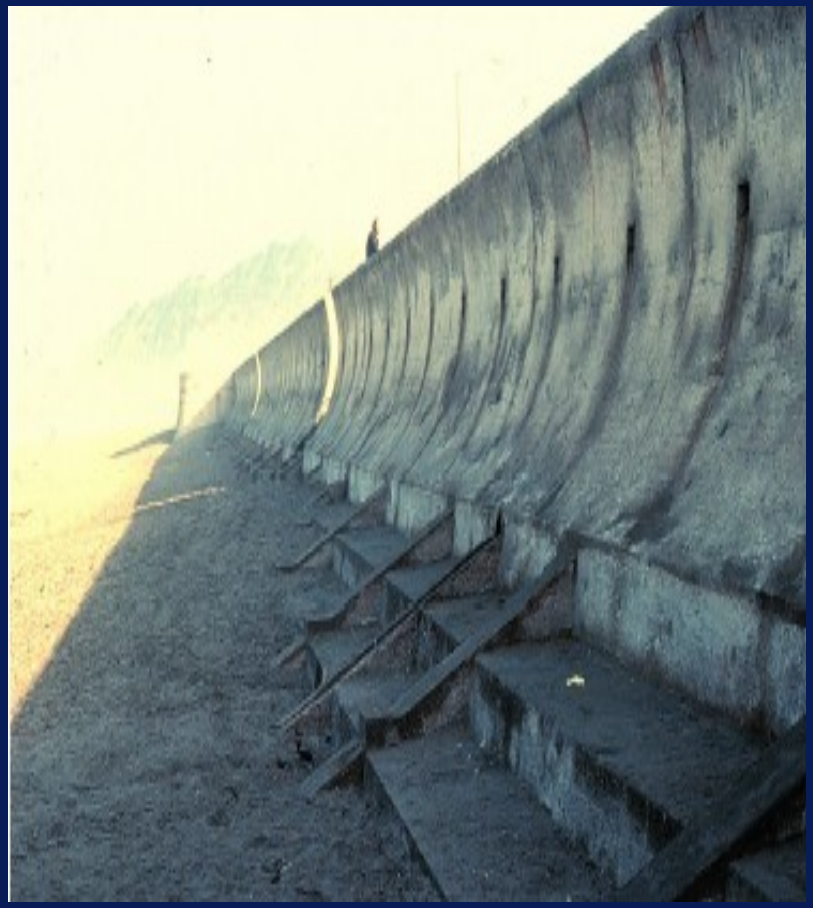
1. **Coastal armoring structures**
2. **Beach or soil stabilization structures**
3. **Navigation structures**

1. Coastal Armoring Structures

- Seawalls
- Dikes
- Revetments
- Bulkheads

Consider if erosion rates are greater than 3 ft/yr

Seawalls



O'Shaughnessy Seawall,

San Francisco, CA

- Prime objective is to protect land and structures from flooding and overtopping
- Secondary function is to hold fill (bluff, shoreline) in place
- Generally massive
- High wave energy application

Seawalls

Curved Concrete Seawall La Jolla, CA

Hereford Inlet Seawall Wildwood, NJ

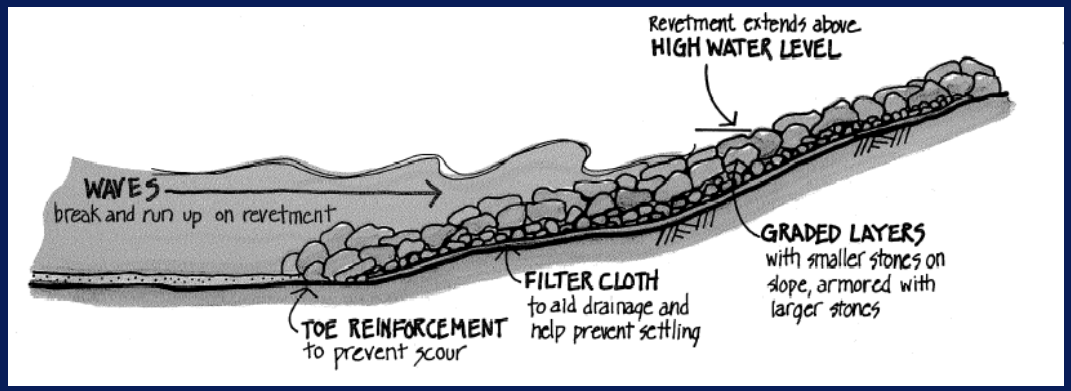
Dikes

- Containment dike primary objective is to stabilize perimeters of marshes or dredge disposal islands
- Generally low energy application

Revetments

Barnegat North

- **Purpose is to protect the shoreline against erosion**
- **Function is reinforce part of the beach profile**
- **“Medium” size**


Revetment extends above HIGH WATER LEVEL
WAVES break and run up on revetment
GRADED LAYERS with smaller stones on slope, armored with larger stones
FILTER CLOTH to aid drainage and help prevent settling
TOE REINFORCEMENT to prevent scour

Revetments

Fort Fisher, NC (Before)

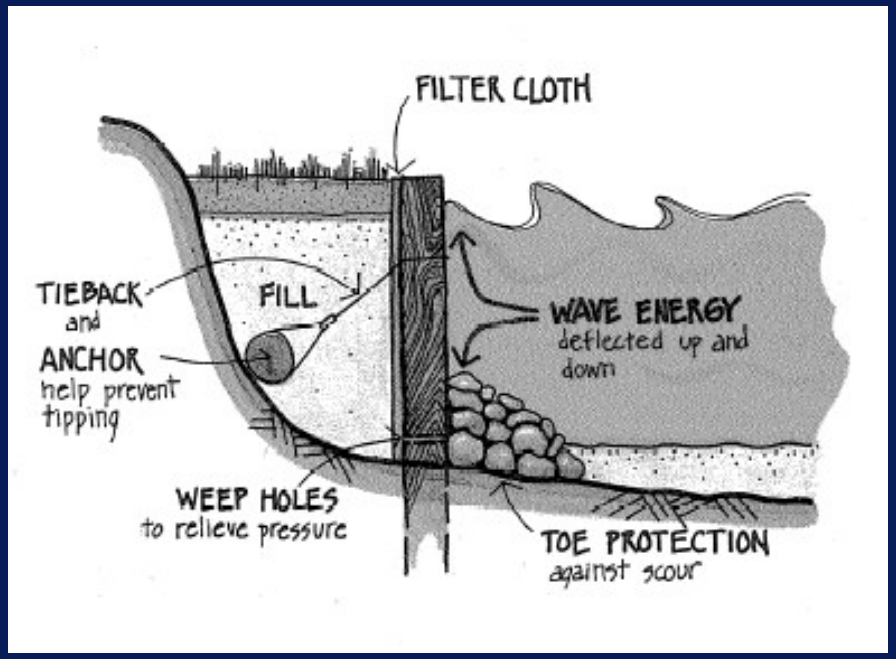
(After)

Photo: Dennis Williams

Gabion Revetment
Cape May Pt, NJ

Geotube Revetment

Bulkheads



- Objective is to retain soil and prevent sliding of land
- Function is reinforcement of the soil bank
- “small”

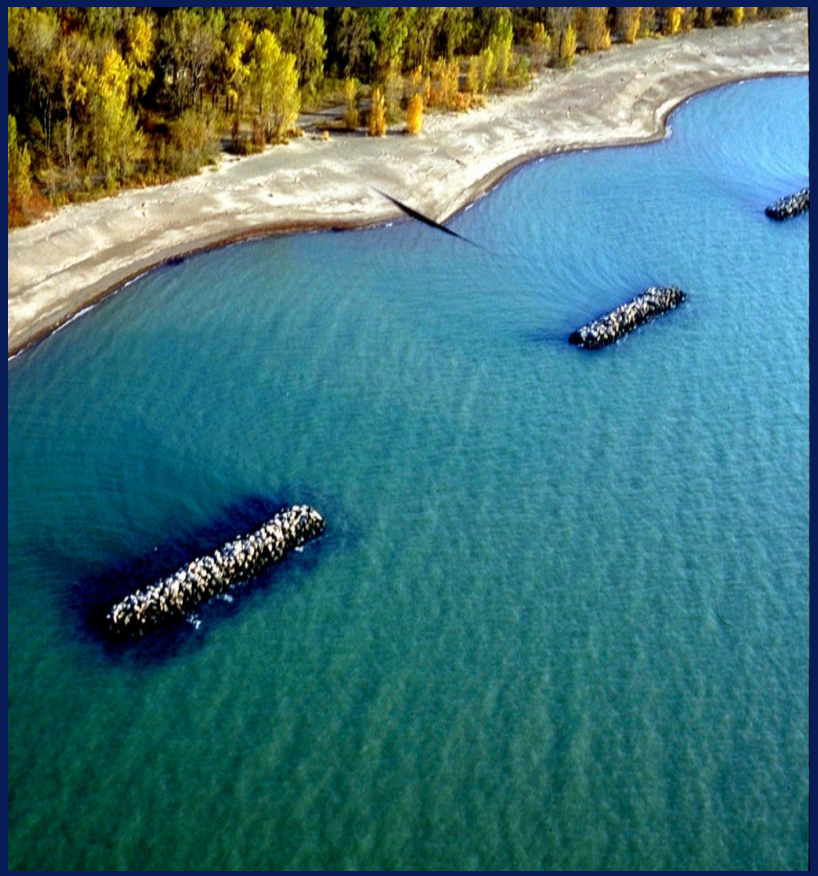
Coastal Structures

1. Coastal armoring structures
2. Beach or soil stabilization structures
3. Navigation structures

2. Beach or Soil Stabilization Structures

- Nearshore (detached) breakwaters
- Groins
- Reefs and sills ("perched beach")

Nearshore (Detached) Breakwaters

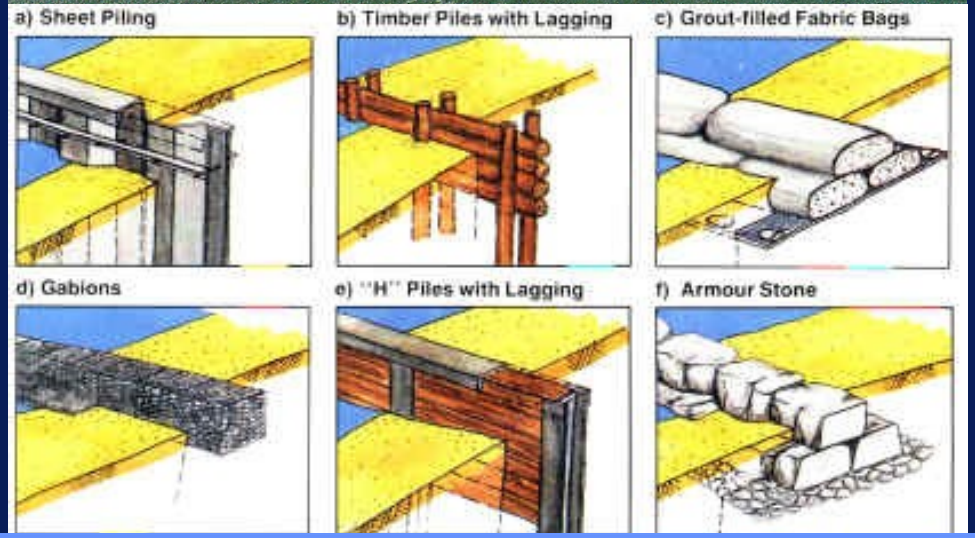


- Purpose is to prevent beach erosion
- Function is reduction of wave energy in lee and reduction of longshore transport
- Parallel to shoreline

Nearshore (Detached) Breakwaters

Maumee Bay State Park

Groins

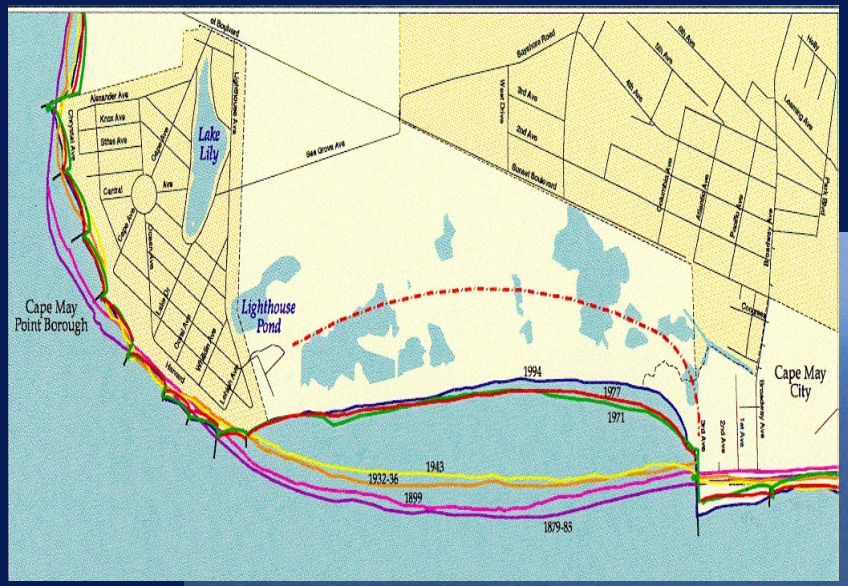


- Purpose is to prevent or reduce beach erosion, or terminate beachfill
- Function by trapping longshore transport
- Generally perpendicular to shoreline

Groins

Cape May Meadows, NJ Shoreline Change 1933 - 1995

Groins

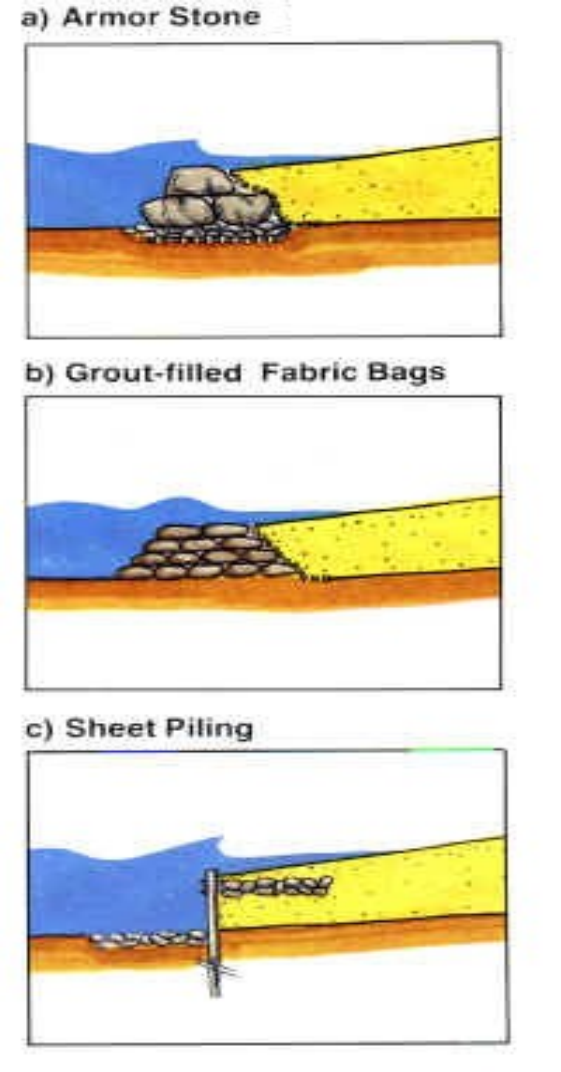


Cape May City

Lower Cape May Meadows

Cape May Poin

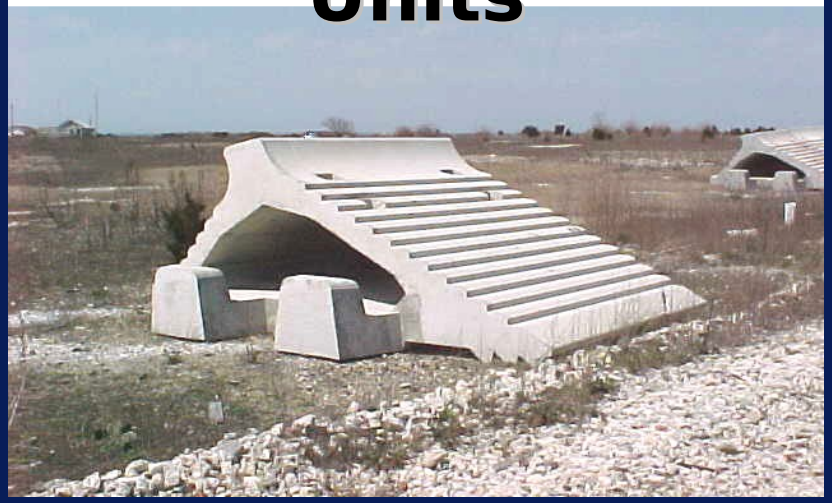
Submerged Reefs and Sills



- Purpose is to limit beach erosion
- Reef breakwaters function by reducing waves at the shore
- Submerged sills are used to slow offshore movement of sand, shorten fill profile

Submerged Reefs and Sills

"Beachsaver" Units



Scour Apron

Double-T Units

Combination of Structures

Chicago, 31st Beach

Coastal Structures

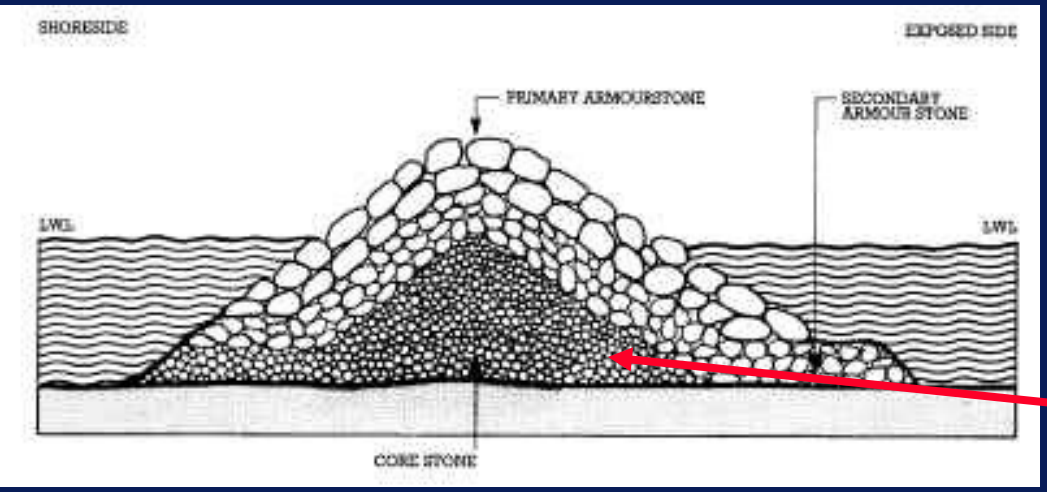
1. Coastal armoring structures
2. Beach or soil stabilization structures
3. Navigation structures

Navigation Structures

Breakwaters

Jetties

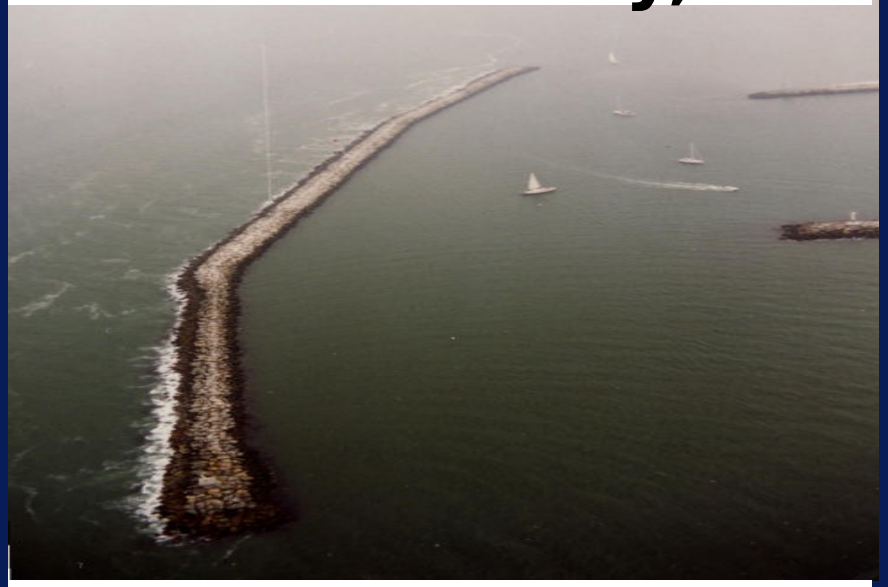
Repair of North Jetty Yaquina, Oregon (2000)

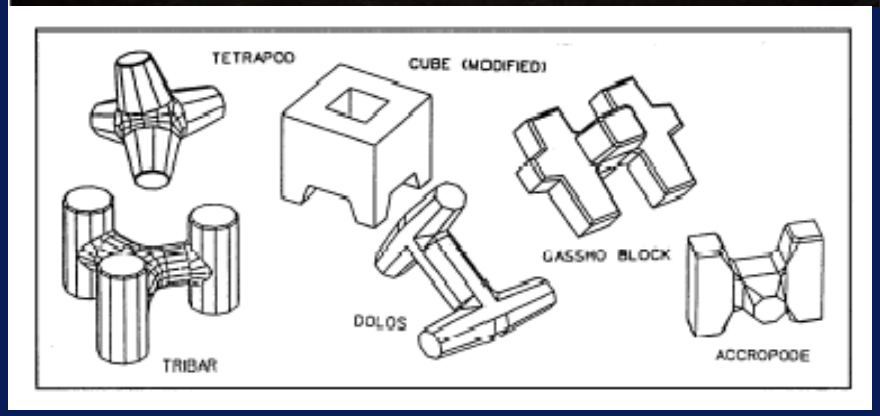


Layered to prevent loss of small material through gaps in larger material

Breakwaters

Marina del Rey, CA





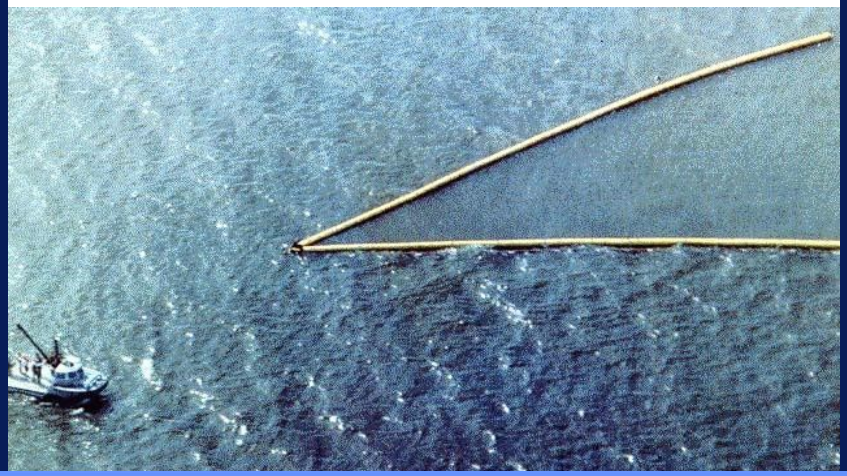
- Purpose is to shelter harbor basins and entrances against waves and currents primarily for boat traffic
- Function by dissipating and reflecting wave energy

Breakwaters

Burlington Breakwater

Lake Champlain, VT

Floating Breakwaters



Sines Port, Portugal

Manasquan Inlet, NJ

Jetties

Barnegat Inlet, NJ

Spur Jetties
Siuslaw River, OR

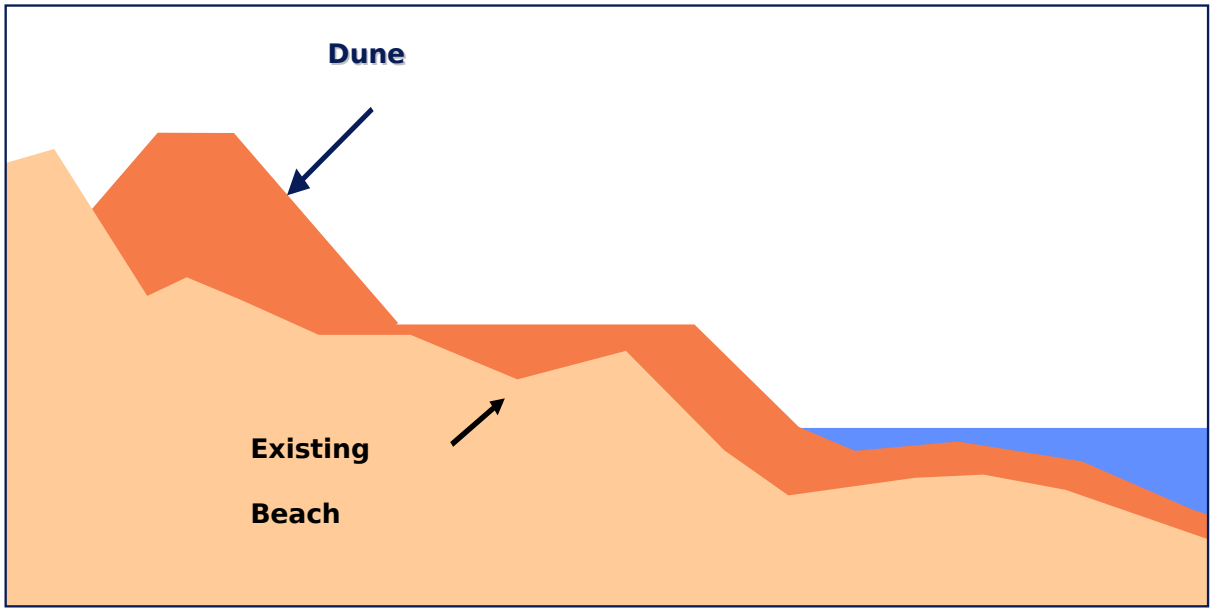
- Purpose is to reduce sedimentation of channels
- Shelter harbor basins and entrances against waves and currents
- Limit inlet migration

Combination of Structures

Ventura Harbor, CA

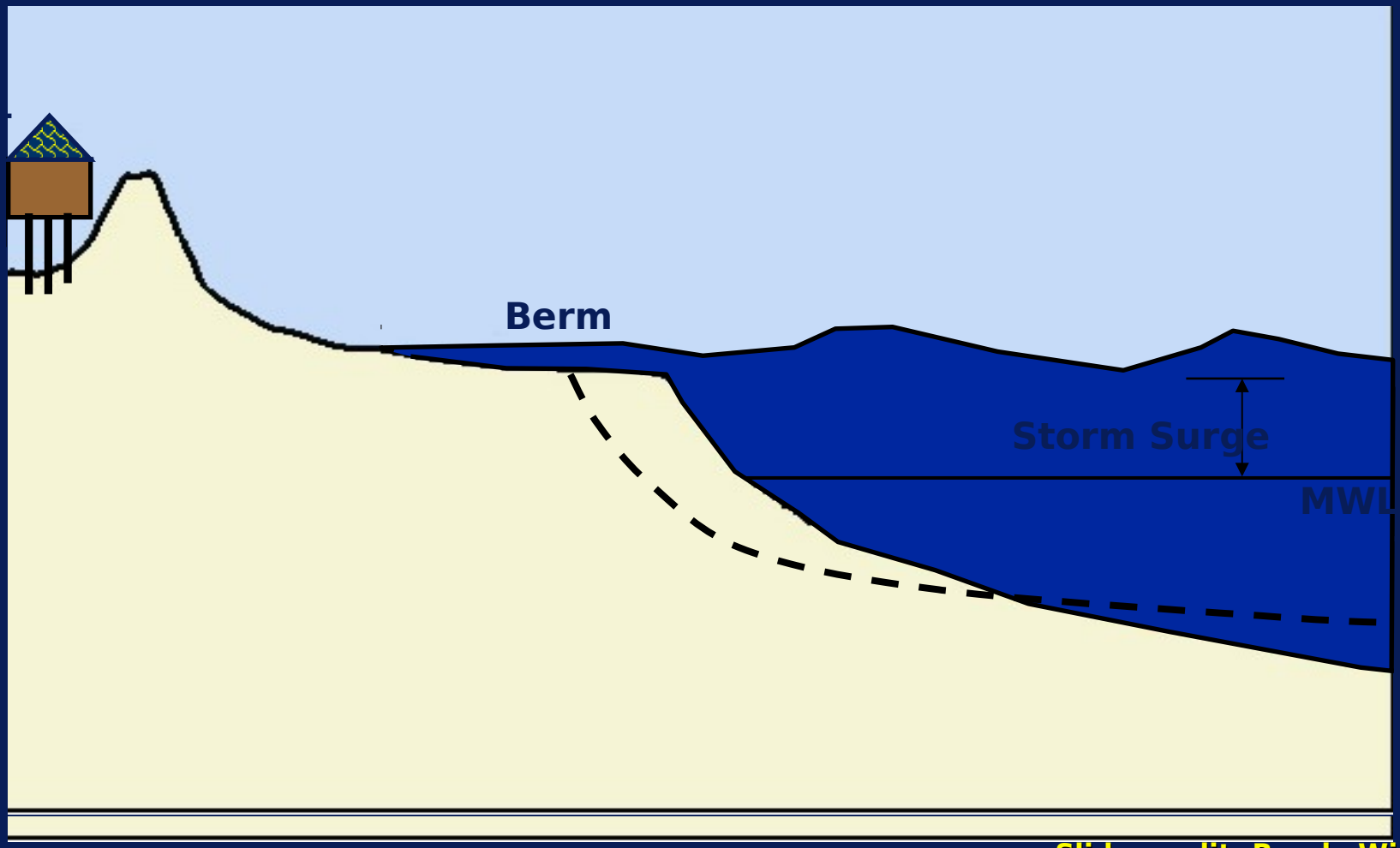
Beach Nourishment

Most common type of project constructed by the Corps of Engineers for coastal storm damage reduction over the last several decades!



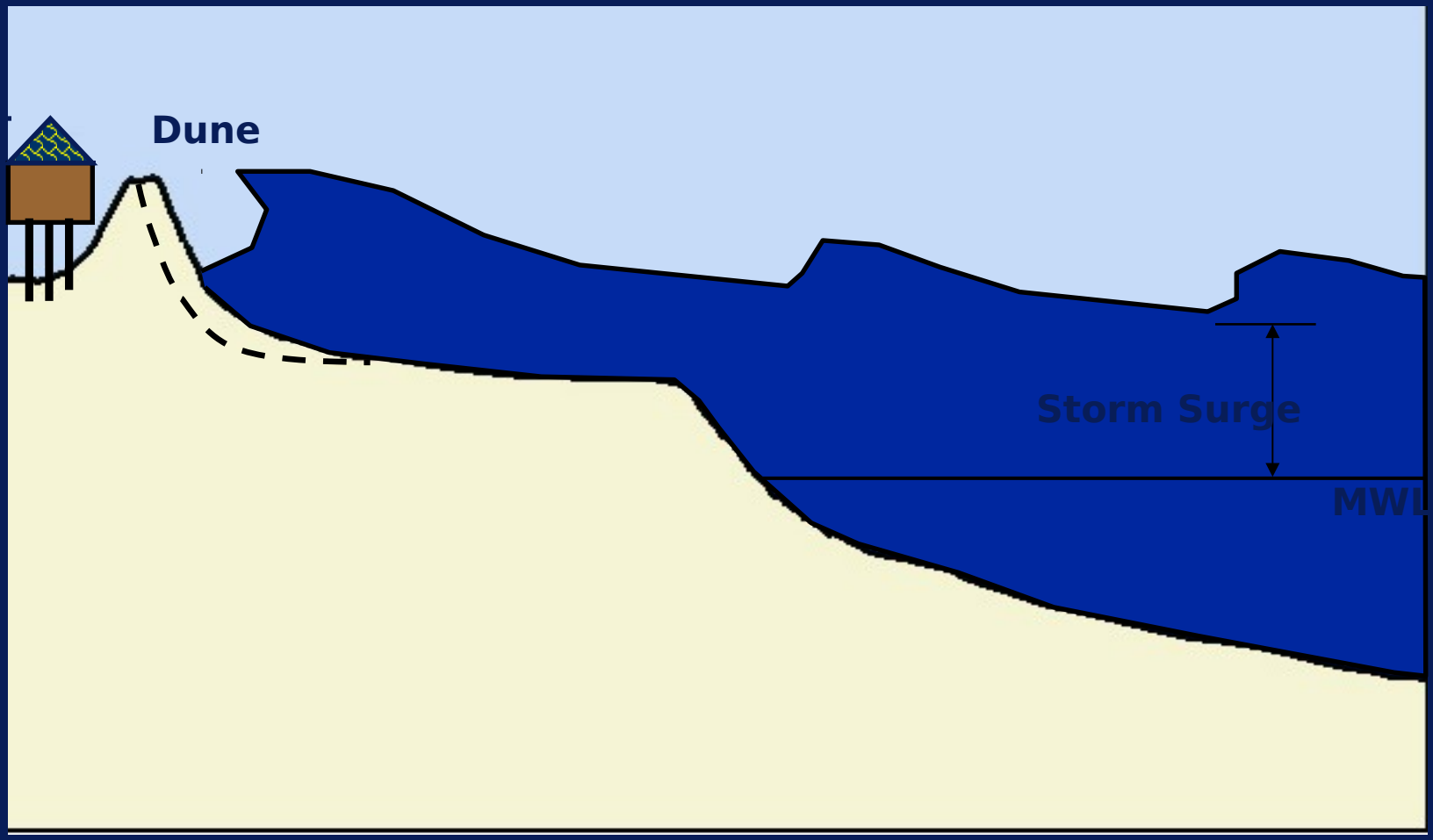
Cross Section

Beach Nourishment



Slide credit: Randy Wise, NAP

Beach Nourishment



Slide credit: Randy Wise, NAP

Great Egg Harbor Inlet and Peck Beach (Ocean City, NJ)

Before **After**

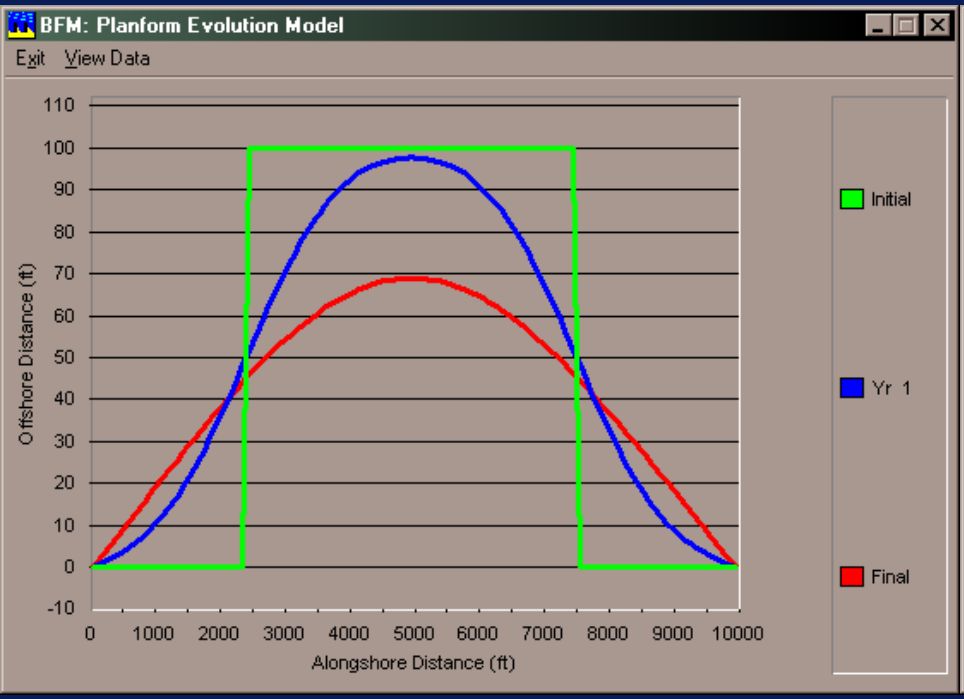
Cape May Inlet to Lower Township

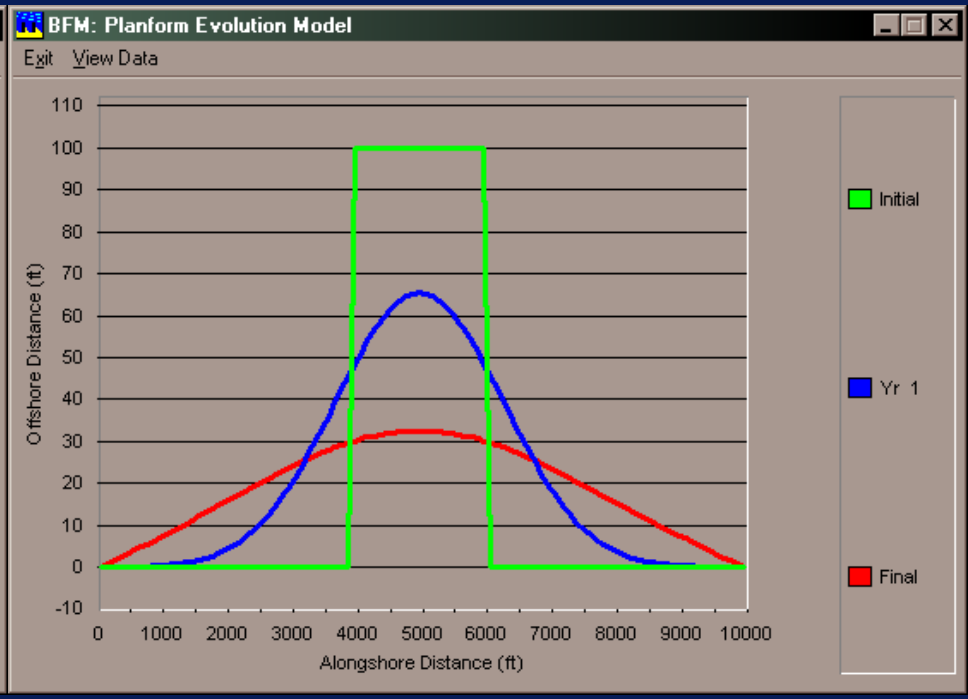
Before **After**

Cape May Point

Before **After**

Shoreline Change – End Losses





Summary of Coastal Tools to Reduce Damages in the Coastal Zone

Damage Mechanism	Structural	Non-Structural
Flooding	Dike Revetment Seawall	Flood proofing Managed Retreat Zoning Buy outs
Erosion	Breakwaters Groin Revetment Bulkhead	
	Beach nourishment Geo-tube	

Planners Need to Know:

1. Planning Issues
2. Design/Engineering Issues
3. Construction Issues
4. O&M Issues

1. Planning Issues

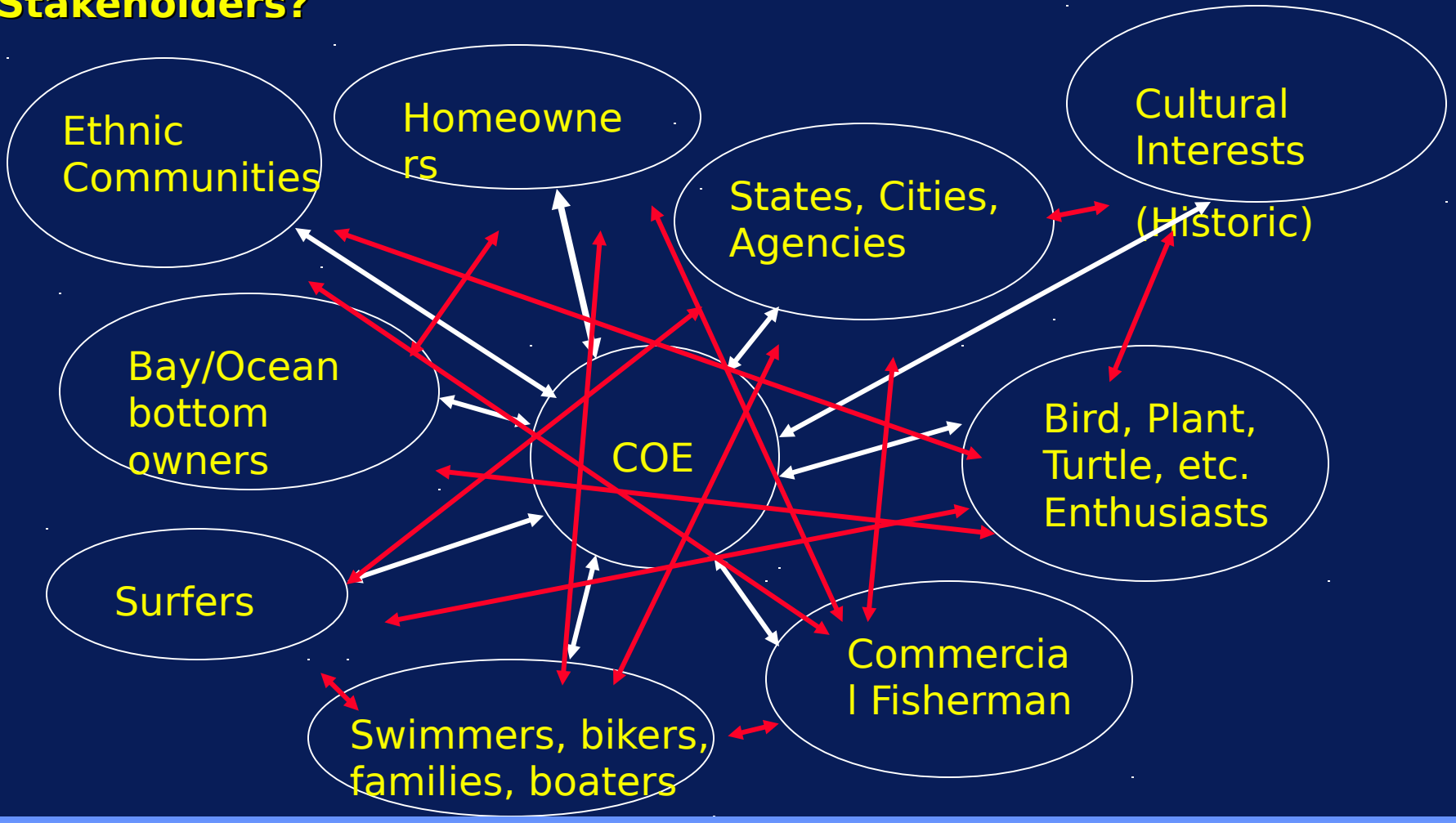
Function – what are you trying to do?

- **Storm damage reduction**
- **Recreation**
- **Environmental enhancement, mitigation**
- **Interaction with beachfill**
- **Navigation**

1. Planning Issues

Who are all the Stakeholders?

Stakeholders often don't agree!



1. Planning Issues

Project boundaries – what happens at edges

– where to place boundaries!

1. Planning Issues

What won't the project do?

- Corps attempts to control nature

- Nature is not controllable

1. Planning Issues

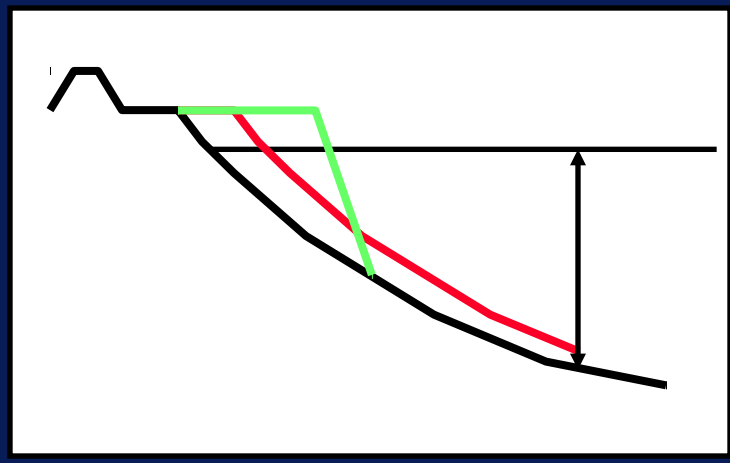
What will the COE/non-fed do when problems occur over the project life

- **COE generally does not build and then walk away**

1. Planning Issues

Common beach profile design issues :

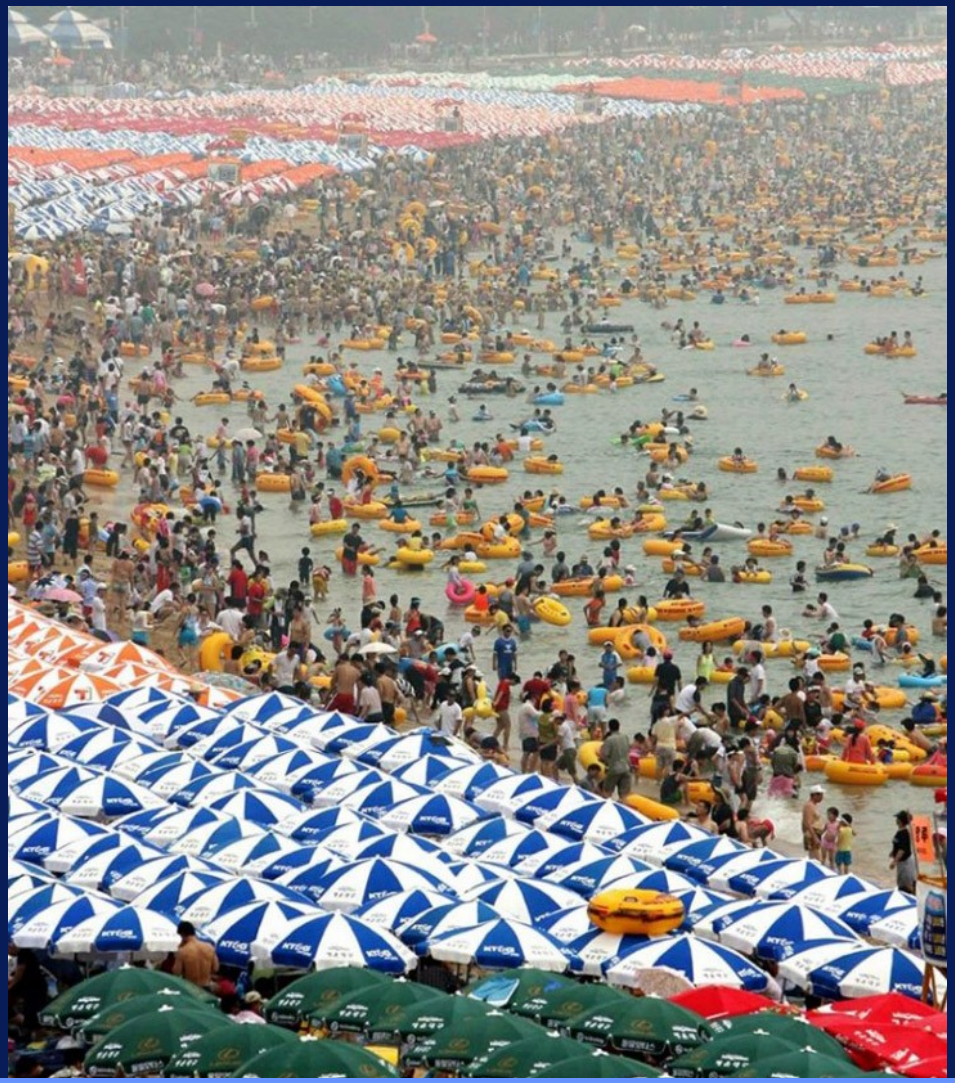
- B/C Ratios usually Greater for Higher Dunes than Wider Berms
- View and Access Issues
- Perception of Project Performance -Construction Profile vs. Design Profile



1. Planning Issues

Recreation

- Must be incidental in the formulation process
- Can be used in combination with damage reduction benefits for project justification
- Can't be more than 50% of benefits required for justification
- If criterion met, all recreation benefits can be included in BCR



1. Planning Issues

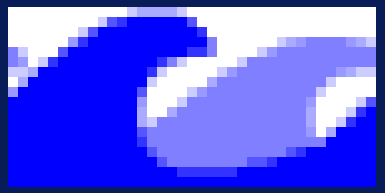
Site Characterization

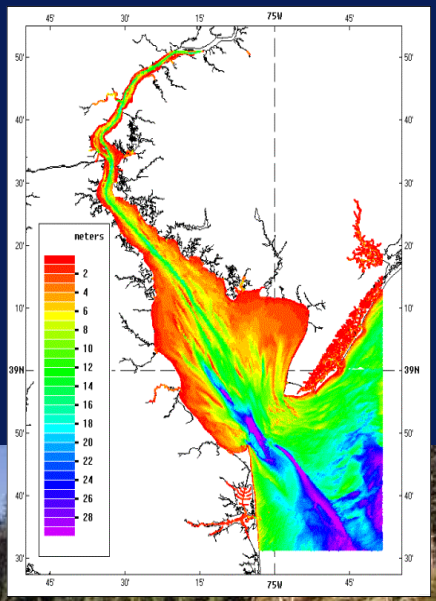
Physical Features of the Coast

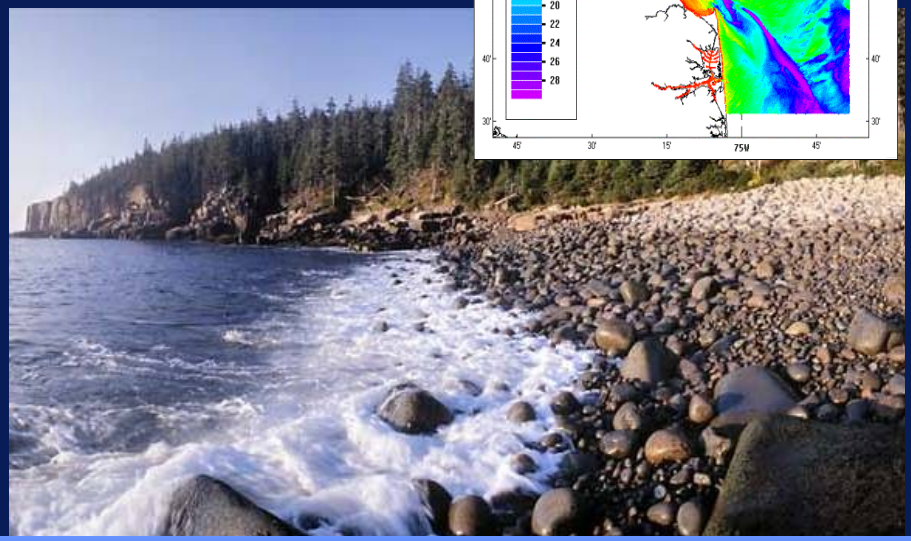
Forcing Conditions

Historical and Existing Conditions

(infrastructure)







1. Planning Issues

Other factors to consider

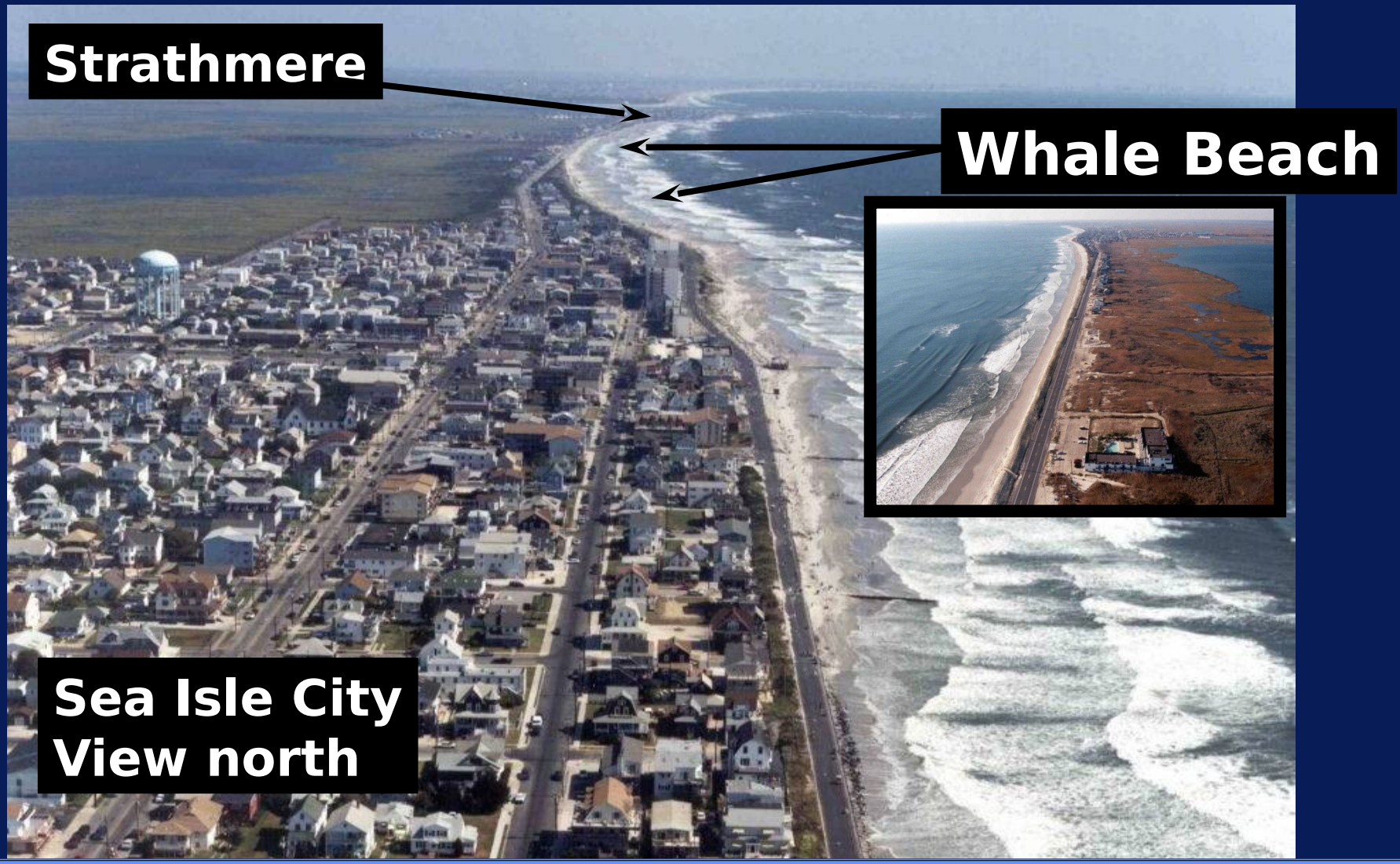
Technology:

- How can we do enough science and engineering to make our predictions believable?
- High cost of numerical and physical modeling
- State of the art in coastal processes analyses changes over the course of a large feasibility study

Sociological:

- Surfing
- Dune Height
- Public Access
- Other Recreational Issues
- Retreat

1. Planning Issues



1. Planning Issues

1. Planning Issues

2. Design/Engineering Issues

How will the structure affect every element of the environment?

2. Design/Engineering Issues

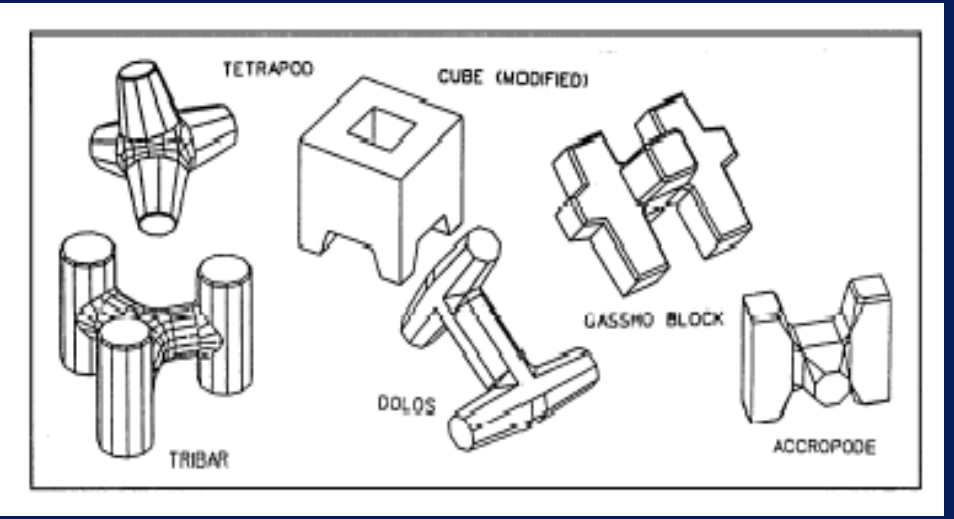
Infrastructure Encroachment

2. Design/Engineering Issues

How harsh is the site climate?

- **Materials, type of structure applicable**

- **Site specific waves, water levels, coastal processes**



2. Design/Engineering Issues

Montauk Lighthouse:
1950 seawall

Expected life of Structure

- **40-years for well-designed, well-built rock structure on East Coast**
- **6-years on West Coast (groin, jetty heads)**

2. Design/Engineering Issues

How structures fail, what happens after?

Failure Categories

1. **Functional: Doesn't do what is should**
2. **Structural: Falls apart**
3. **Design Exceedance: Is overwhelmed**
4. **Old Age: Has outlived expected performance life**

2. Design/Engineering Issues

Failure examples: Functional

Westhampton, NY
Incomplete prior construction (1960's)

Coney Island, NY
Groin head collapsed.

2. Design/Engineering Issues

Failure example: Structural

Long Branch, NJ

2. Design/Engineering Issues

Failure examples: Design Exceedance

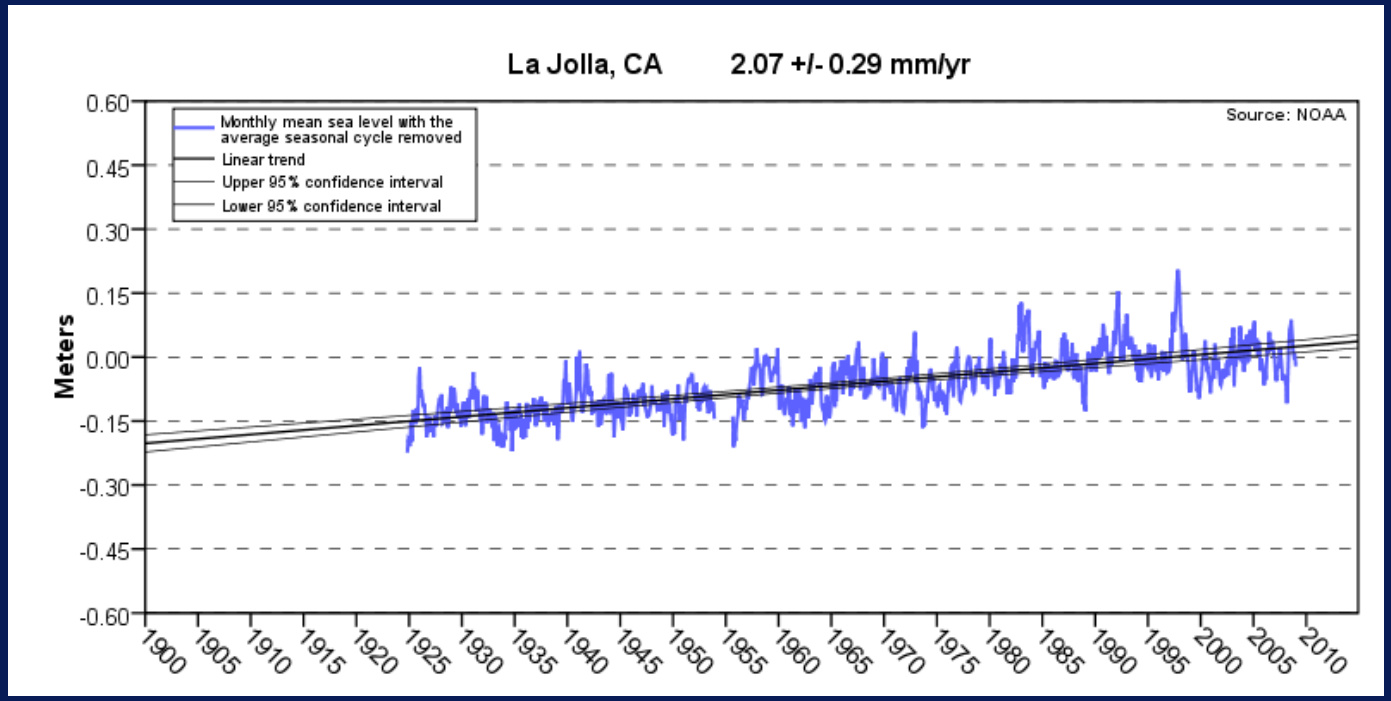
2. Design/Engineering Issues

Failure example: Old Age

Montauk Point
Seawall

2. Design/Engineering Issues

Sea Level Rise - Potential Impact



Impacts - Shoreline retreat, upland erosion, reduction in flood protection from structures (seawall, revetment, etc.)

3. Construction Issues

Site Conditions:

- **Water v.s. Land Access**
- **Work in Surf Zone**
- **Disturbance to Community**

Westhampton, NY - Reconstruction of Groin

3. Construction Issues

Environmental restrictions – When & where can work be done

Pumping sandfill, Sea Bright 1999

Piping plover

Kemp's Ridley sea

3. Construction Issues

- **Partially built structures/projects**
- **Public safety during construction**
- **Contracting limitations**

Montauk Revetment Toe Construction 1992

Umpqua, Oregon

3. Construction Issues

Prepare for the Unexpected

March 20, 2007

US Army Corps of Engineers
Philadelphia District

Surf City Beach Nourishment Update

Military munitions found on beach at Surf City nourishment site

Within the last two weeks, military munitions (examples pictured at right) were recovered from the beach at Surf City, N.J. To date approximately 20 items have been safely recovered without incident.

Items were all turned over to the Surf City Police who called the State Police Bomb unit, and ultimately to the Army's Fort Monmouth 754th Ordnance Company, responsible for Explosive Ordnance Disposal (EOD). Many of the items found were empty. However, a number of the items have been determined to be potentially dangerous unexploded ordnance.

The devices were manufactured in the U.S. prior to World War II and used during the war. An ordnance disposal expert in the unit assessed that the items containing explosives had the potential to cause loss of limb, of eyesight and, under the right circumstances, to cause loss of life.

Because of the potential danger of handling such ordnance, the Corps has taken a number of steps to safeguard the public.

What has been done so far?
Our number one priority is public safety. Immediately after the first suspicious objects were discovered, the Corps took action to close the project area and began plans to conduct a thorough investigation of the site using advanced screening devices.

Safety fences have been placed at all street-end entrances and along the boundaries of the project site, and warning signs (pictured at right) will be going up throughout the project site. Security guards are on site patrolling 24 hours a day to assist in public safety.

What lies ahead?
Over the next few weeks, specialists from the Corps' Military Munitions Center of Expertise will begin the detailed investigation of the extent and nature of the ordnance located on the beach. Upon completion of the investigation, they will remove all detectable ordnance for proper disposal.

The Corps will expeditiously and thoroughly survey the project area and will take whatever steps are necessary to remediate the area as quickly as possible.

How does this affect you?
Beaches will remain closed to all activity (both recreation and construction) until the investigation and clearing operation is completed.

We greatly appreciate your cooperation in helping keep people off the beach during this process.

We advise anyone who finds any suspicious items to not disturb them and to call either their local police department or 911 immediately.

For updates, visit the Philadelphia District website at:
www.nap.usace.army.mil
or
Contact the information hotline at: 215-656-6931 and choose menu option 2.

For additional information, contact the district's public affairs office at 215-656-6595/6515.

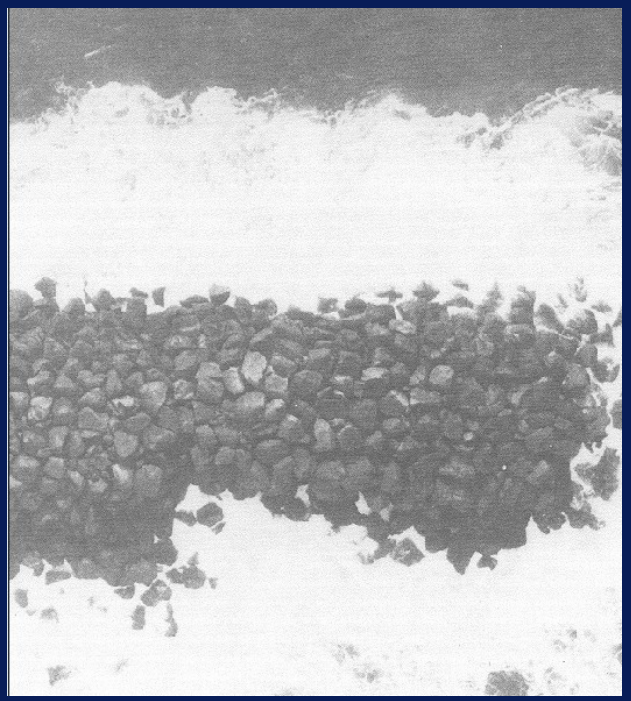
DANGER

UNEXPLODED ORDNANCE FOUND
BEACH CLOSED
UNTIL FURTHER NOTICE
DO NOT ENTER

4. Operation/Maintenance Issues

Inspections

Dolos breakage on Crescent City, CA breakwater (CEM Figure VI-8-1)



Aerial photogrammetry image of Yaquina, Oregon north jetty (CEM Figure VI-8-

4. Operation/Maintenance Issues

Monitoring – What (biological, physical), how long and why

Spring Lake, NJ Hotspot

- Aerial Photography
- Profiles, Sediment Sampling
- Hydrographic Survey of Borrow Areas
- Wave Measurement
- Hot Spot Analyses (as needed)
- Site Visits
- Analysis/Reports/GIS/Dissemination
- Costs must be included in project

4. Operation/Maintenance Issues

Maintenance/Repair

Backpassing Sand

Dune Building

Beach Grading

Restoring Wildlife Habitat

H&H Coastal Engineers can:

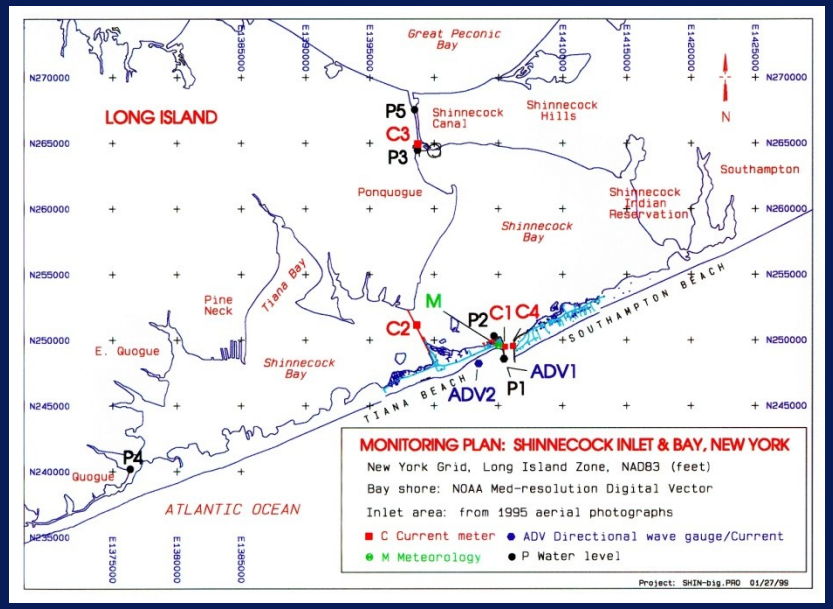
- Model Wave Climate
- Model Cross-Shore Sediment Transport
- Model Currents and Inlet Processes
- Model Water Levels including Storm Surge
- Model Long-shore Sediment Transport (Shoreline Change)

However, we are going to need:

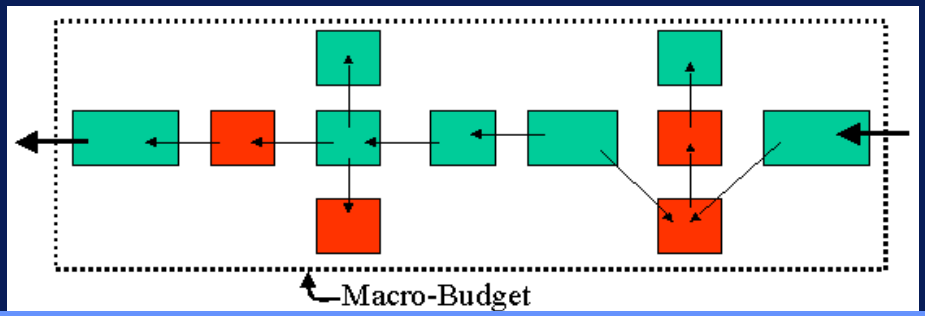
- Topography
- Bathymetry
- Aerial Photography
- Sediment Characteristics – both for the existing beach and or the fill material
- Wave Climate (waves, winds, water levels, etc.)
- Historical Storms - Parameters, Damages, etc.
- Constraints (sponsor preference, rights of way)

Show me the $$$

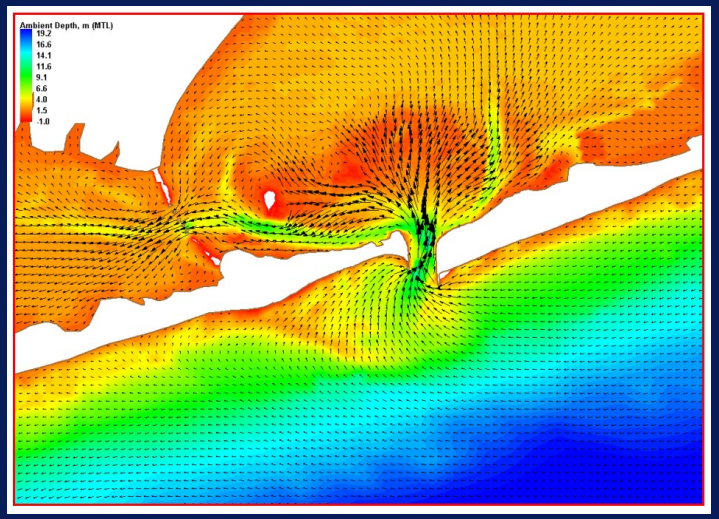
1. Data Collection & Analysis



2. Sediment Budgets



3. Numerical Models



4. Physical Models

Summary

Provided an overview of the types of projects that the Corps typically is involved with in the coastal zone. Two broad areas – navigation and hurricane and storm damage reduction were covered.

Described shore protection alternatives.

Introduced typical planning issues associated with coastal projects.

Briefly identified coastal engineer data needs.

Questions

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